

DECIPHERING THE FLUVIOMARINE SEDIMENTATION RECORD OF THE NORTHERN CALIFORNIA CONTINENTAL SHELF: A HIGH-RESOLUTION C-14 GEOCHRONOLOGICAL APPROACH

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LONG-TERM GOALS

The overarching goal of this research was to understand the temporal and spatial variability of sediment accumulation rates on river-dominated continental shelves with regard to the magnitude and variability of river-sediment influx and coastal ocean transport processes. Elucidating natural and anthropogenic influences on shelf sedimentation was a particular goal. These issues, relevant to continental shelves worldwide, must be rigorously addressed to develop a process-based understanding of the recent stratigraphic record.

OBJECTIVES

The major objective of this research was to develop high-resolution C-14 geochronologies for piston cores collected in the northern California shelf STRATAFORM study area. The C-14 dating program was designed to constrain the absolute ages of sedimentary strata and the frequency of river paleofloods during the past several thousands of years as a means to extend the 20th Century instrumental record of river discharge.

APPROACH

Sedimentary records of STRATAFORM piston cores (60-150 m water depths) were the focus of this study. Detailed C-14 dating of sedimentary materials using Accelerator Mass Spectrometry (AMS) methods, age-depth modeling, and description of down-core sedimentology (grain-size and X-radiography) were performed. The sedimentary records were interpreted in the context of the Eel River discharge history based on terrestrial geologic records of megafloods, U.S. Geological Survey river gage data, and sediment-transport observations made by other STRATAFORM research groups.

RESULTS

All sedimentological and geochronological work initially proposed has been completed. The results of this project together with those of subsequent, related ONR grant (to C. Sommerfield, # N00014-01-1-0168) formed the basis for three meeting presentations, one published paper, one paper in review, and another in preparation (see Publications). In addition, the C-14 datasets have benefited the greater STRATAFORM research community by providing information on the ages of strata imaged via high-resolution seismic profiling and which are essential for groundtruthing numerical models of strata formation.

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Radiocarbon analyses were used to develop detailed chronologies for 12 piston cores, which have provided new insight on the response of shelf sedimentation to continental hydrology. Based on the results, we discovered that continental-shelf deposits off the Eel River document a recent increase in the magnitude and frequency of major hydrologic floods (≥ 10 yr recurrence interval). The shelf record reveals a sudden, threefold increase in sedimentation rate around 1954 and a concomitant increase in the frequency of preserved flood beds. Comparison of sedimentary and river-discharge records reveals that major floods after about 1950 had a more pronounced effect on coastal sediment delivery and accumulation offshore than previous recorded events of similar magnitude and further that stratigraphic preservation of flood events is highly dependent on flood frequency and net sedimentation rate.

Based on these observations we contend that this change in marine sedimentation is a response to documented climatic phenomena that have increased the frequency of major floods throughout the western United States during past half century, together with intrabasinal impacts of extreme floods in 1955 and 1964 (Sommerfield et al., in press). Anthropogenic increase in watershed-sediment production is a probable secondary factor. Overall, the results have shed new light on the sensitivity of river-shelf sedimentary systems to flood magnitude and frequency, as well as on the preservation of hydrologic signatures in marine records.

TRANSITIONS AND RELATED PROJECTS

The results of this research have been utilized by STRATAFORM scientists investigating the formation, modification and preservation of sedimentary event layers (R. Wheatcroft, OSU; J. Borgeld, HSU; C. Nittrouer, UW), continental slope sedimentation (C. Alexander, SIO), and methods of stratigraphic modeling (D. Swift ODU). During FY00, the C-14 data were used in concert with high-resolution seismic data generated by other STRATAFORM research groups to interpret the depositional history of the Eel shelf.

PUBLICATIONS RESULTING FROM GRANT

- Sommerfield, C.K., Drake, D.E., and Wheatcroft, R., 2002. Shelf record of climatic changes in flood magnitude and frequency, north-coastal California. *GEOLOGY* (in press).
- Stark, C.P., Driscoll, N.W., Sommerfield, C.K., Weissel, J.K., Restrepo, C., Hovius, N., Yun, J.W., 2002. The importance of active continental margins in the sequestration of biomass-derived carbon. Submitted to *Earth and Planetary Science Letters* (submitted).
- Sommerfield, C.K., and others. Sediment Dispersal and Accumulation on Seasonal-Millennial Timescales. In: C. Nittrouer, J. Austin, M. Field, M. Steckler, J. Syvitski, and P. Wiberg, (Eds.), *Continental-Margin Sedimentation: Transport to Sequence* (in prep.).
- Sommerfield, C.K. and Wheatcroft, R.A., 2001. Hydrologic and oceanographic controls on Modern-Late Holocene sediment accumulation on the U.S. North Pacific Shelf. *Chapman Conference on the Formation of Sedimentary Strata on Continental Margins, Abstracts with Programs*, p. 25.
- Sommerfield, C.K., Drake, D.E., and R.W. Wheatcroft, 2000. Marine record of fluvial disturbance, North-Coastal California. *EOS*, Transactions of the American Geophysical Union, 81:48, p. F 631.
- Sommerfield, C.K., 1998. Decadal to millennial variability of fluviomarine sedimentation on the northern California shelf. *EOS*, Transactions of the American Geophysical Union, v.79/154 (supplement): p. F457.

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14. ABSTRACT

The following summarizes the goals, objectives, approach and results that were achieved in understanding the temporal and spatial variability of sediment accumulation rates on river-dominated continental shelves with regard to magnitude and variability of river sediment in-flux and coastal ocean processes.

15. SUBJECT TERMS

Fluvio-marine; Strataform; Continental Shelf

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